BELLCOMM, INC.
955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D. C. 20024

B70 01024

SUBJECT: Program Review of α-Particle and X-Ray Spectrometers, American Science and Engineering, December 17, 1969 Case 340

DATE: January 15, 1970

FROM: W. L. Piotrowski

ABSTRACT

A Program Review for the α-Particle and X-Ray Spectrometers was held at American Science and Engineering (AS&E) on December 17, 1969 to review the progress of the instrument development program at AS&E.

AS&E is proceeding with the design of both instruments and has begun fabrication of some components. However, some design questions remain unresolved, particularly the type of actuator for moving the X-ray calibration source into position and a satisfactory design for a low voltage power supply.

The documentation for both experiments appears to be progressing satisfactorily. Preliminary drafts of some of the required documents have been reviewed by MSC, and AS&E informed of the necessary modifications. AS&E anticipates that the required documentation will be completed and all design questions resolved for the Critical Design Review to be held on January 13-15, 1970.

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MEMORANDUM FOR FILE

A Program Review for the α-Particle and X-Ray Spectrometers was held at American Science and Engineering (AS&E) on December 17, 1969 to review the progress of the instrument development program at AS&E. A list of attendees is shown in Attachment I.

The current design for the α-Particle Spectrometer is shown in the block diagram of Figure 1. The spectrometer consists of: 1) a collimator with a 90° field-of-view, 2) a detector composed of 10 silicon surface barrier detectors (each 3 cm^2), and 3) processing electronics. Eight digital lines sampled at 10 times/sec and three analog lines (detector temperature, detector identification, and instrument dead time) sampled once/sec plus housekeeping lines have been allocated to the α-Particle Spectrometer.

The X-Ray Spectrometer design is shown in the block diagram of Figure 2. The spectrometer consists of: 1) a collimator with a 60° field-of-view, 2) three gas-filled proportional counters with .001" Be windows, 3) absorption filters which precede two of the proportional counters, one of .4 mil Mg and the other of .2 mil Al (the third counter is unfiltered), 4) an X-Ray calibrating source, 5) processing electronics, and 6) a Solar Monitor consisting of a single proportional counter plus processing electronics. Eight digital lines sampled 10 times/sec and two analog channels sampled once/sec have been allocated for scientific data from the X-Ray Spectrometer.

The α-Particle and X-Ray Spectrometers share a common integrating structure except for the Solar Monitor which is housed in a separate package. This arrangement will permit the spectrometers to be isolated from each other electrically but not thermally. The integrated package is about 54" wide, 14" high, and 26" deep, weighs 127 lbs, and will occupy the lower shelf of the SIM. The Solar Monitor weighs about 20 lbs and will be mounted on the opposite side of the SM from the SIM. Multi-layer insulation blankets will cover the packages to isolate the experiment hardware from the spacecraft.

AS&E is proceeding with the design and fabrication of components for both instruments. The status of the α-Particle Spectrometer as of December 17 was:

1) Detectors - AS&E will obtain 19 detectors from Ortec, some of which will be used for special engineering tests and the remainder used for the prototype.

2) LVPS or Low Voltage Power Supply - Satisfactory design not yet obtained. (Will also be used in X-Ray Spectrometer.)

3) Processing Electronics - Electrical design completed and packaging design underway. A/D Converter being assembled by Spacetac.

As of December 17, the status of the X-Ray Spectrometer was:

1) Proportional Counters - The first three lunar counters and the first solar counter will be delivered to AS&E in January for the prototype. Subsequent deliveries will be at the rate of three lunar counters and one solar counter/month.

2) HVPS (High Voltage Power Supply) - Design review was satisfactory and a breadboard model has operated within specifications. The HVPS prototype will be delivered to AS&E in January for evaluation.

3) Processing Electronics - Explorer design being utilized for preamplifier, amplifier, and pulse shape discriminator. Manufacturing will commence when parts are delivered. Electrical design for counter, shift register, and multiplexer almost complete.

4) Calibration Actuator - No decision yet on type of mechanism to use.

5) Filters - Mounting design complete.

Gordon Engineering, under contract to AS&E, will build four sets of ground support equipment (GSE). The first set of GSE will be delivered to AS&E in January. The GSE is designed to provide a go no-go check for the spectrometers, and present plans are not to provide this unit with any diagnostic capability.

Preliminary copies of the Failure Mode Effects Analysis (FMEA) and Single Point Failure Summary (SPFS) for both instruments were distributed at the meeting. MSC will review these documents prior to the CDR.

A draft of the GSE End Item Specification was reviewed by MSC. MSC also commented on a rough draft of the End Item Specification for the flight hardware.

Several additional items of interest were:

1) NR, MSC, and GSFC are preparing a radiation survey of the CSM in order to better define the environment for the geochemistry experiments. CM 105 has been identified by NR as a possible test bed. GSFC would also like to jettison the LM ascent stage prior to experiment operation and have the thermoluminescent point removed from the CM switches.

2) AS&E performed a thermal shock test on a silicon wafer by pouring liquid N_2 over it at ambient temperature and then performing a visual inspection to assess the damage. No cracks were noted in the wafer. However, no electrical functional checks were performed on the detector either before, during, or after the test.

3) A silicon surface barrier detector loses resolution as the detector temperature increases, and the bias voltage should not be applied when the temperature is above 40°C lest the detector be damaged. For this reason a thermistor switch removes the bias voltage from the α-Particle detectors when the wafer temperature reached 40°C. However, no analysis or tests have been performed on the α-Particle detector to determine the detector temperature during lunar orbit operational periods. Consequently, it is not known whether the α-Particle Spectrometer will be able to obtain data through a full orbit or whether only operation over unlit portions of the moon is possible. We would suggest that the detector temperature be measured over a simulated lunar thermal cycle.

The Critical Design Review for the α-Particle and X-Ray Spectrometers will be held at AS&E on January 13-15, 1970. AS&E anticipates that by this time all the required documentation will be completed and all design questions resolved.

W. L. Piotrowski

2015-WLP-gmr

Attachments
Attendance List
Figures 1 and 2

ATTENDANCE LIST

α-Particle and X-Ray Spectrometer Program Review
AS&E, December 17, 1969

M. R. Hoes	AS&E/Lunar Program Manager
G. R. Vrablik	AS&E
A. J. Sos	AS&E/Reliability
J. A. Stein	AS&E/Project Scientist
C. J. LeBlanc	MSC/EA-6
L. E. James	MSC/S&AD
C. D. Purple	MSC/GE (R&QA)
C. C. Boette, Jr.	MSC/Boeing (Safety)
R. L. Schmadebeck	NASA/GSFC
W. L. Piotrowski	Bellcomm

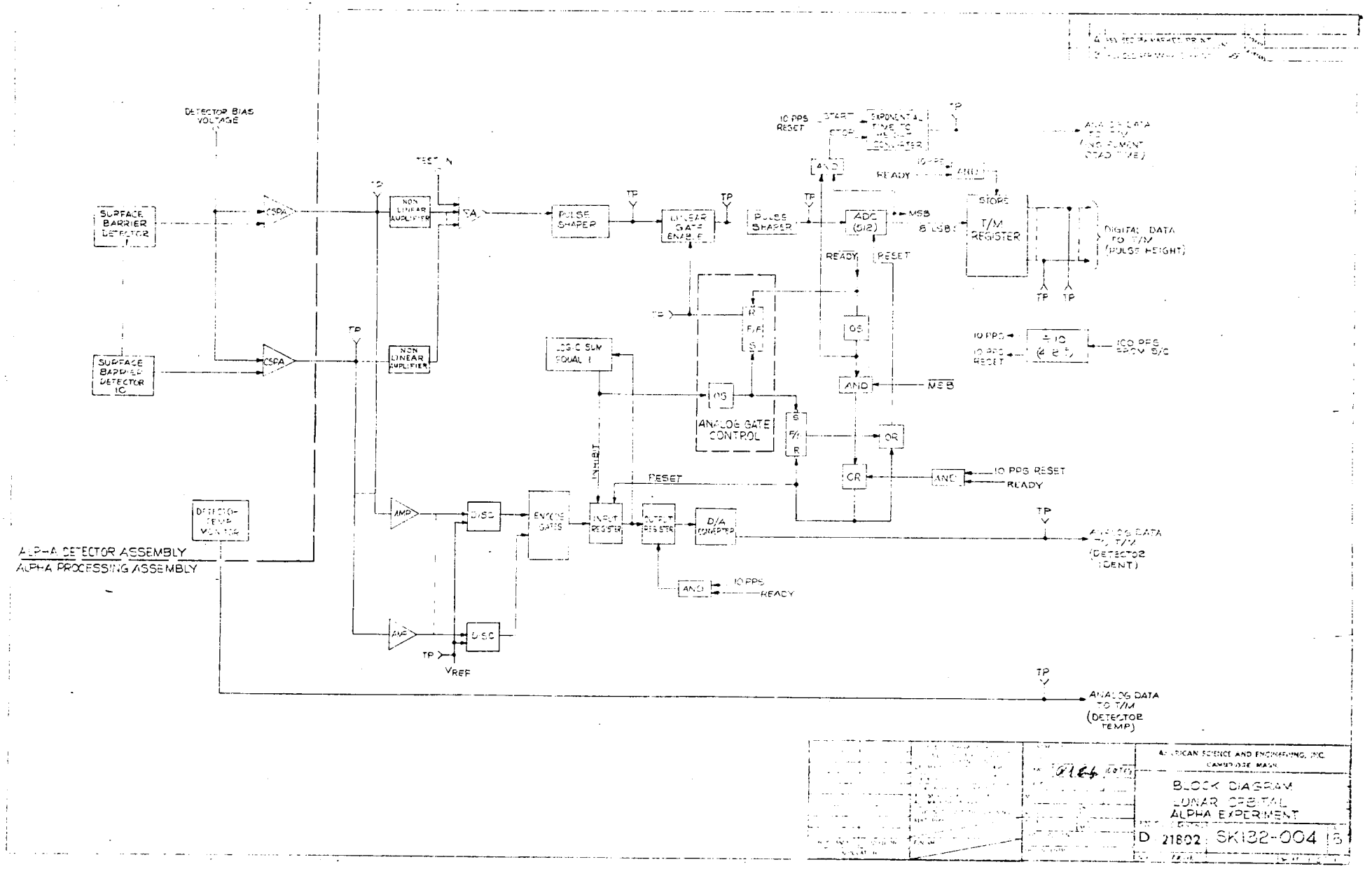

Figure 1 - BLOCK DIAGRAM FOR α-PARTICLE SPECTROMETER

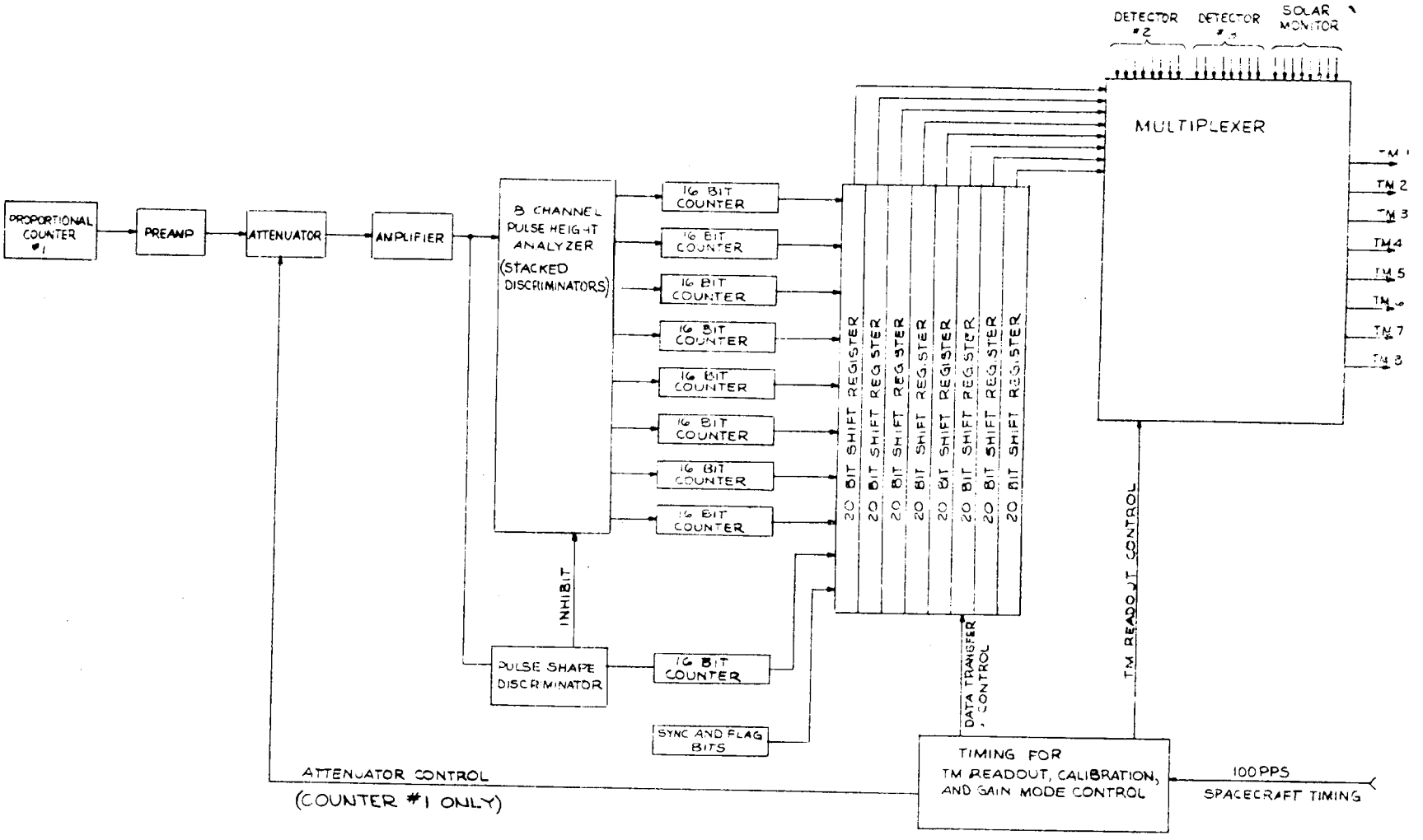

Figure 2 - X-RAY EXPERIMENT BLOCK DIAGRAM

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